Space Weather Technical Forecast

Issued on Wednesday 12 February 2025 at 01:16 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of Isolated M-class flares. Chance G1 Minor Storms, most likely late Day 2 into Day 3 (12-13 Feb) due to CH14 fast winds.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one isolated M-class flare observed, peaking M1.6 at 11/0535 UTC from AR3981. This has been the most active region on the disc, however this has recently rotated over the northwest limb. There are seven sunspot regions currently on the visible disc, however these are generally small and simple. AR3990 in the southeast, is perhaps the most notable, however this appears to be a mature region dominated by its large leader, with only limited complexity or activity.

No Earth directed CME's were observed from available imagery. A weak filament eruption off the southwest at 11/0120 UTC was deflected far south, likely by the fast winds from the large coronal hole, while a further filament eruption was observed just southeast of centre disc, however no CME has been identified. A third eruption occurred on 11/1810 UTC from the southeast limb, most likely sending material behind Earths orbit.

Solar Wind / Geomagnetic Activity: The waning influence of the fast wind of CH13 was observed. Solar wind speeds initially around 580km/s saw a slow decline to around 510km/s. Density was near or just below average. Interplanetary Magnetic Field strength, Bt, was weak between 5-6nT. The north-south component, Bz, was also weak and variable in direction, slightly favouring negative (southwards-directed) conditions, ranging between -5nT to +5nT. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Unsettled to Active (Kp3-4).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 persisted at background. High energy electron flux (greater than 2MeV) at GOES16 was Moderate, with diurnal peaks of high, peaking 2080 pfu at 11/1605 UTC. The associated 24-hour fluence persisted below the Active threshold, recording 5.34e7 integrated pfu at 12/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to Low activity expected with a chance of further M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing fast wind influence from CH13/- is expected to gradually decline during the start of Day 1 (12 Feb), before then transitioning into the fast wind from CH14/- later Day 1 and into Day 2 (12-13 Feb). Initially

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Quiet to Unsettled geomagnetic activity with Active intervals forecast by the end of Day 1 (12 Feb) with a chance of G1 Minor Storms, most likely with the transition into CH14 Days 1-2 (12-13 Feb), and any CIR region that is observed.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background. High energy electron flux observed at GOES16 is expected to see a gradual rising trend, both at first and again later in the period, with the likelihood of periods of High flux. There is a chance for the corresponding 24-hour fluence to rise above the Active threshold during Day 1 (12 Feb) likely returning below the Active threshold by Day 2 (13 Feb). A chance of electron fluence then rising above the Active threshold again from Day 3 (14 Feb).

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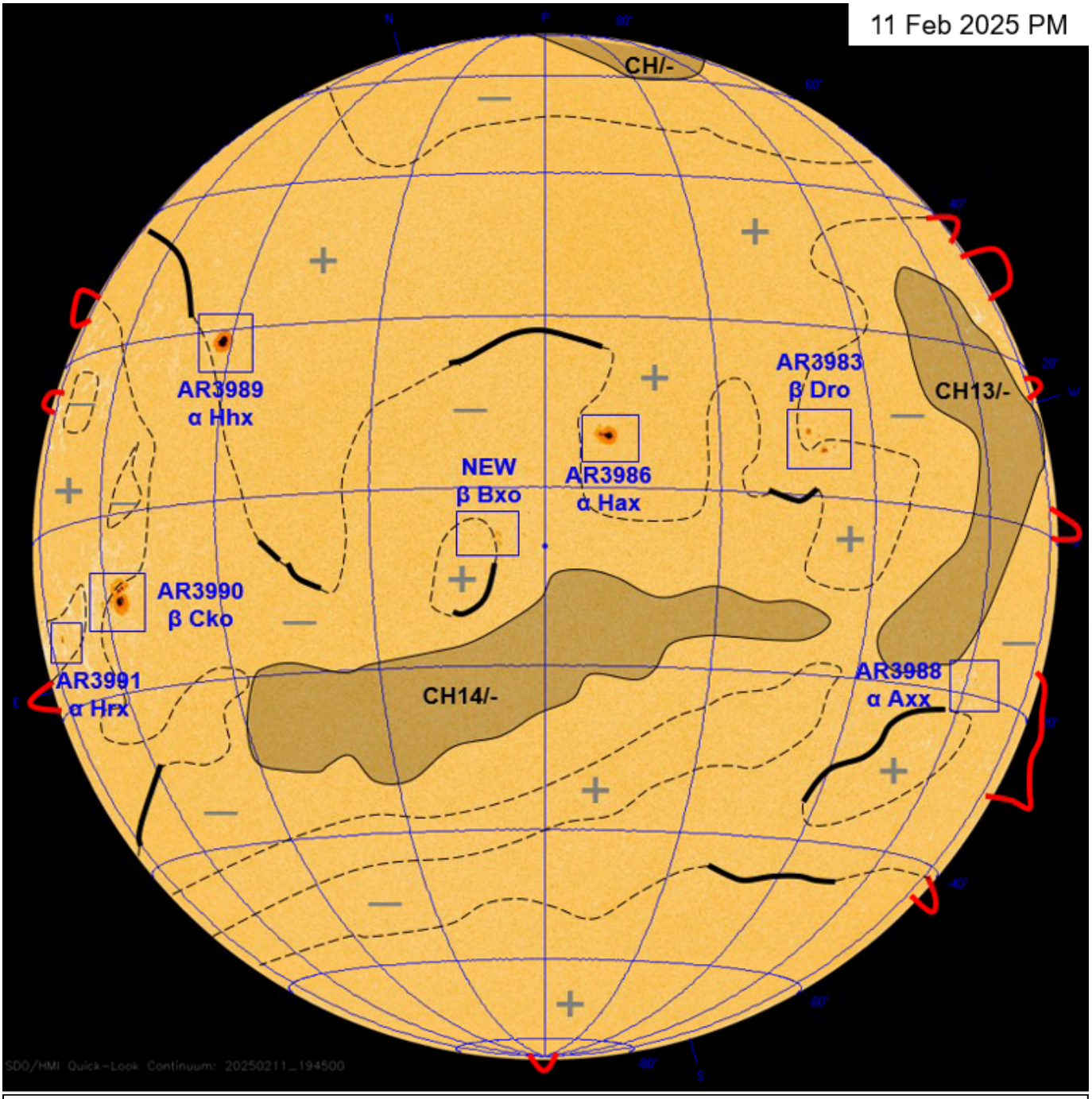
Figure 1: Solar Synoptic Map valid 11/1945 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

While there have been a few notable CMEs from the eastern limb, they are not Earth-directed and are unlikely to bring any enhancement to Earth.

Ongoing fast winds from CH13/- are expected to slightly ease through the first part of Day 1 (12 Feb), gradually easing towards speeds of around 450km/s. The next enhancement is then expected during the second half of Day 1 (12 Feb) and into Day 2 (13 Feb) from a connection to the high speed stream from CH14/-. This is an elongated feature across a similar latitude to Earths current heliographic projection. Any subsequent enhancement from this feature is low confidence in terms of the timing of onset, but is likely to become Elevated to Strong (500-600km/s) by Day 2/3 (13/14 Feb), before persisting at this level throughout the current forecast period. This is largely supported by MOSWOC Enlil, which is showing a slight rise in speed from Day 1 (12 Feb), peaking later on Day 2 (13 Feb).

Quiet to Active conditions expected through the period, with the greatest chance of Quiet periods early Day 1 (12 Feb), and again from late Day 3 (14 Feb) onwards. However, there is a chance of isolated G1 intervals throughout due to the ongoing fast solar winds, but most likely with the onset of CH14/- later Day 1 or early Day 2 (12-13 Feb).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	50	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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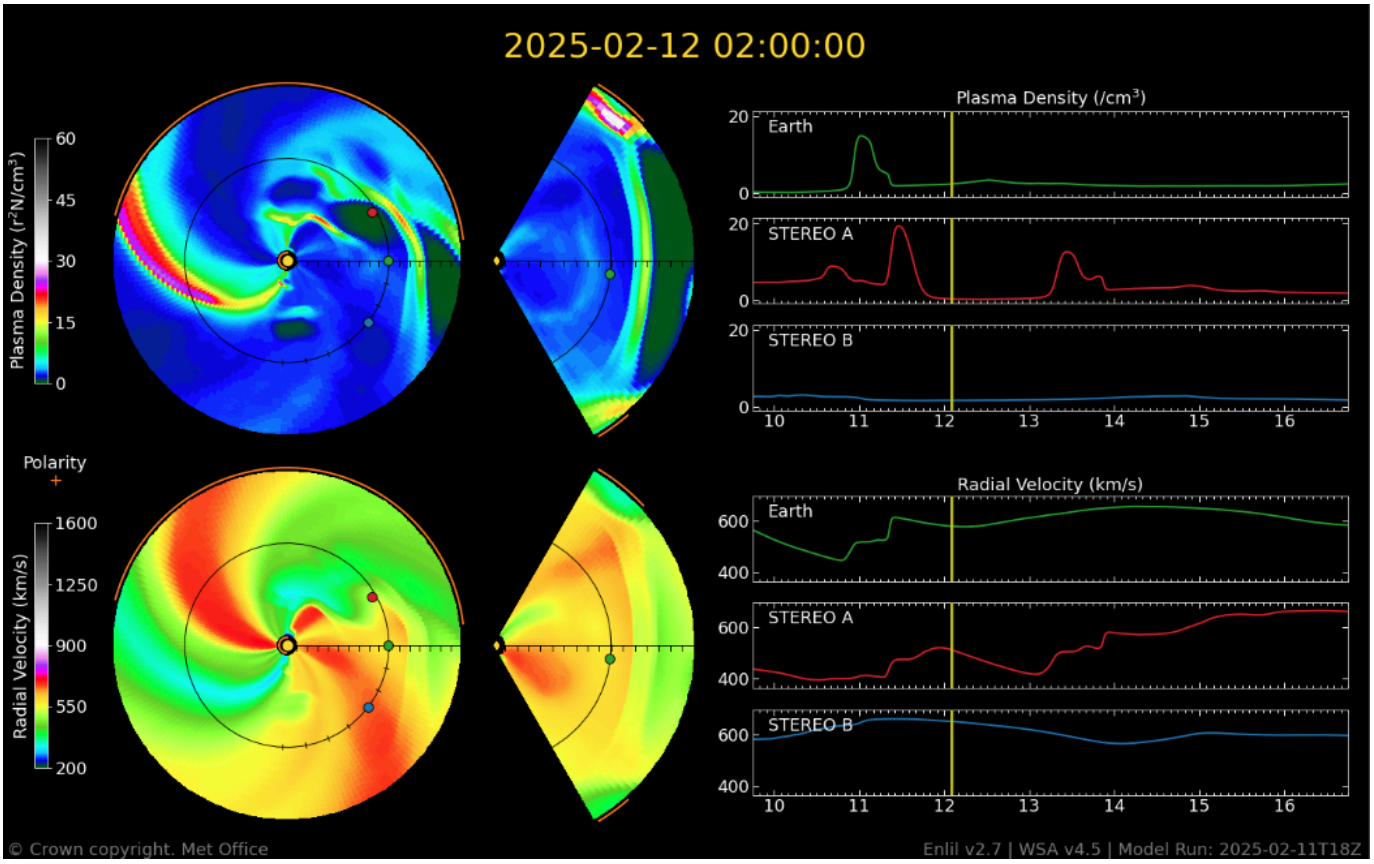
Figure 2: MOSWOC Enlil showing a very brief decline in solar winds as CH13 eases before rising again through 12/13 Feb under the influence of the fast winds from CH14.



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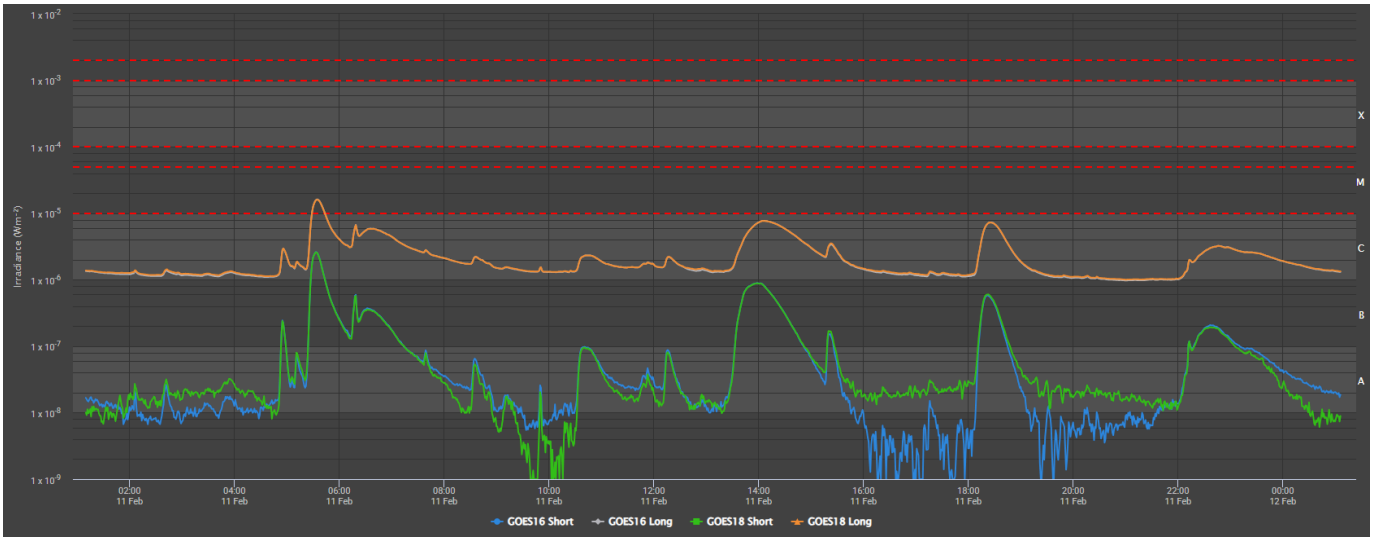
Radio Blackouts - X-Ray Flares

Solar activity has been moderate in the last 24 hours, with one M1.6 flare from the recently departed region AR3981 at 11/0535 UTC. As a result, solar activity is likely remain at low to moderate levels with a chance of isolated M-class flares. A slight increase in probabilities through the period as new regions rotate on to the eastern limb in the coming 48 hours.

There are seven sunspot regions on the disc, with the most notable of these perhaps AR3990 in the southeast. This is comprised predominately of a large and likely mature leader spot, set within a broad area of plage, and followed by a small trailer. This region has remained relatively inactive while on the visible disc, however further details may become apparent as this moves to a less oblique viewing angle. While the other regions remain smaller and simpler, SDO imagery does indicate further clustered magnetic looping beyond the east limb, and recent CMEs from the eastern limb, which could relate to a number of returning regions that could potentially move onto the disc during this period. This is also supported by far-sided sources. This remains low confidence at this stage.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	40	40	50	50
Very Active	R3-R5 (X Class)	No	1	1	5	5

Figure 3: X-ray trace from GOES16&18.



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Solar Radiation Storms (High Energy Protons)

GOES-16 proton flux is forecast to persist at background with only a very slight chance of enhancement from any notable flares. This is initially most likely from AR3981 just over the northwest limb, with some notable magnetic looping evident above the active region. As this continues to rotate further on to the far-side of the disc, the risk of a proton rich flare significantly decreases. Other sunspot regions remain relatively simple and in the eastern hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been largely Moderate with diurnal peaks to high. The ongoing enhancement from CH13/- fast winds is expected to have charged the Van Allen belts for lower orbits, leading to the observed flux rising as winds ease a little and this charge migrates out to GEO. This picture is complicated, however, by the expected further connection to CH14/-, most likely occurring either late Day 1 or Day 2 (12-13 Feb), with the associated onset and any geomagnetic activity likely suppressing the observed flux for a time, before a further rise is expected Day 3 (14 Feb).

There is a chance for the corresponding 24-hour fluence to rise above the Active threshold during Day 1 (12 Feb) and is represented by MOSWOC REFM which is giving reasonable guidance at present. Any geomagnetic activity associated with the onset of the fast winds from CH14/- may see a temporary dip in electron flux and therefor fluence on Day 2 (13 Feb) before rising again by Day 3 (14 Feb).

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^8	No	40	10	20	30
Very Active	≥ 2 MeV ≥ 1×10^9	No	1	1	1	1

Figure 4: MOSWOC REFM output showing a rising trend.

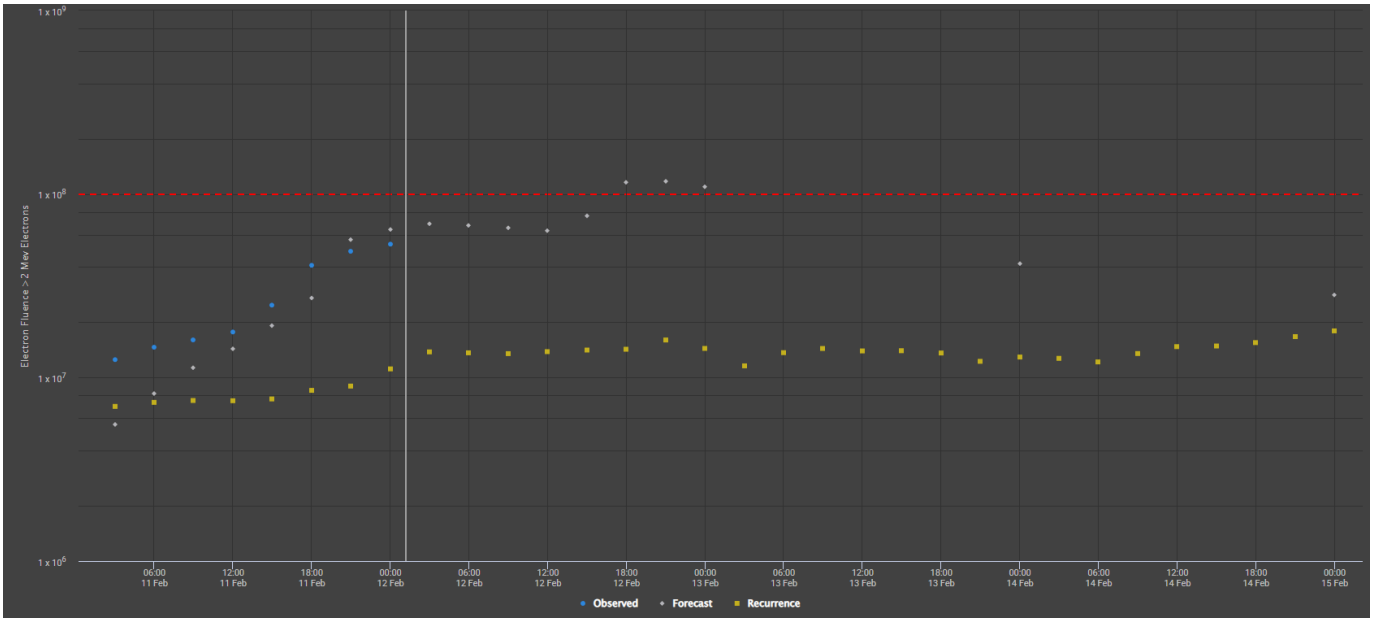

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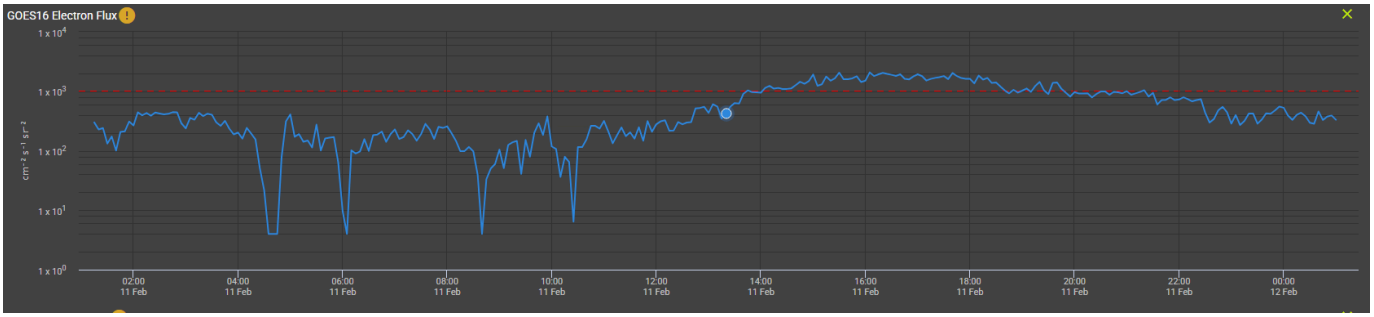
Figure 5: Electron flux trace from GOES 16 over the last 24 hours.



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